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EFFECT OF ELECTRON-ELECTRON INTERACTIONS IN A QUANTUM DOT WITH A TAPERED CONSTRICTION,

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Current technologies for very large-scale integrated circuits (VLSI) are approaching their physical limits. As a result, there are growing efforts to extend the limits by utilizing quantum effects such as the electron-electron correlations in single-electron semiconductor devices of nanometer size.

In this talk, we will examine movements, using theoretical first-principle approaches, of the position of the absolute charge density maximum, of each occupied state in a quantum dot with a tapered constriction under DC electric fields. The tapered neck separates the dot into two regions (left and right sides) and each region has predominantly its own confined states. Two cases with three electrons in the quantum dot are studied: (1) With the initial configuration of one electron in the left side region and other two electrons in the right side region occupying the two lowest energy states of the system. Of the single-electron state moves through the constriction by the resonant tunneling process even though there is no explicit barrier. (2) All three electrons are initially in the left side region, of the occupied states move through the constriction in a competitive manner which is completely different from the situation when all the electrons do not interact.

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